[3.0035]

THE TYPE LOCALITY AND THE STUDY OF NATURAL POPULATIONS[1]

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The greatest drain on the modern systematic entomologist's time is the burden of the original literature. The law of priority, because it requires that every taxon be accounted for, leaves no alternative for the systematist except to deal with all described genera, species, and infraspecies whether or not they are based on sound evolutionary theory. However, a systematist can study natural populations without involving himself in nomenclatural problems, and for one to insist on a complete accounting of all past taxonomic literature often delays work that may lead to the discovery of important biological phenomena. A procedure to circumvent this problem, which at the same time permits thorough work within the requirements of the rules of the International Code of Zoological Nomenclature, is proposed below. This is done by fitting previous taxonomic work into the population concepts of species resulting from field studies, without the necessity of solving useless nomenclatural puzzles.

The natural species is defined after the results of the data on the component natural populations have been analyzed, in contrast to the non-dimensional species concept of the old-time naturalist (ref. Mayr, 1963: 17), or the museum taxonomist's concept based on mechanical differientation. In groups that are poorly known and poorly studied, it cannot help but be true that natural species are really unknown, and the methods of the taxonomist are no different than those of the field biologist. But once a significant number of populations have been observed, there is a chance that isolating mechanisms and the evolutionary potential of the populations leads to an understanding and appreciation of our living environment and justifies systematics.

A study of populations requires almost exactly the same procedure as studies at the species level. The systematist estimates by sampling the most useful para-

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meters, including variance, of the populations of a species. Until the systematist learns this, he is unable to procede further with his work because he lacks a foundation upon which he can build. Unless the data on populations are organized and used, future generations of systematists will be forced to continue to deal with the past taxonomic literature.

The use of the phenogram[3] (Arnett, 1963) is one way to synthesize population data and is an approach toward the solution of a systematic problem by a field biologist. The phenogram provides a graphic means of assigning the holotype or neotype specimen to the exact population of which it may have been a member. This is done by making a list of all of the major distinguishing features to be found in a single genus, with all of the known variations, distributed in a series of from two to ten states. *This includes all known intraspecific variations* as well as interspecific differences. Many systems already purport to do this in a sophisticated manner but are very tedious, may include expensive computer time, and many really are faulty systems. So far, these procedures have been done to demonstrate a particular phenomenon and as yet have not achieved the status of a routine, as have, for example, genitalia preparations in insects. As a working hypothesis, the features listed for the phenogram are assumed to be influenced either by a single gene or by a gene complex. The proof or disproof of this hypothesis may be one of the chores of the gamma taxonomist, and, of course, can not be done in most groups. The connection between the various descriptions and nomenclature is apparent when it is understood that the contents of a description is the postualtion of the natural species, while the publication of the name is the process of nomenclature.

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[3]Although the term *phenogram* has priority and is etymologically more appropriate as I have used it (Arnett, 1963), it is necessary that I redefine it here because, like the term genotype taken over by the geneticists, this term has been assumed for another use. My 1963 definition of a phenogram still holds as a modified histogram showing the pattern of phenotypic characters of an individual, a sample, a population, or a species by plotting the the position of many characters and their states in graphic form. In 1965 the phenogram was redefined (Camin and Sokal) as a phenetic dendrogram (*sic*; **graph** means connecting lines, while **gram** means a drawing or a picture, hence *histogram*) as opposed to a cladogram (*sic*), a cladistic (=phylogenetic) dendrogram (*sic*) and even though my 1963 paper was referred to, the term was used instead of the more appropriate term, *phenograph.* More recently Sokal (1966) has again used phenogram incorrectly as a phenetic dendrograph without regard to priority or etymology which is even more important.

NOTE: This paper, written several years ago, was refused publication in two national journals with the comment that the author "is listening to a different drummer." This may not be the right "drum", but considering the slow progress being made by taxonomists, and the low regard for taxonomy held by many scientists, it seems that a "different drummer" is needed.

To avoid *a priori* thinking, the systematist compares the holotype specimen with the natural populations rather than the converse. The phenogram treats the existing nomenclature with a maximium of objectivity and tests are readily available enabling the fitting of a single specimen (e.g., a holotype) into a population, once sufficient samples have been gathered (ref. Simpson, *et al.*: 182). For well known species, which in some cases have no existing holotype, and no designated neotype, the problem for the student of natural species is simple since he accepts species as he recognizes them from his field studies. His problem is to determine the homogeneity or heterogeneity of the aggregate populations. Then by the restriction of the type locality to the area of a single population, even in the cases of sympatric sibling species, the need for a neotype becomes less important, and may even be eliminated. This does not apply to those relatively few cases where the exact type locality has been destroyed. By a designation of the population from which the holotype was selected, a very useful purpose is served, for it fixes a unit population from which genetic and/or phenetic change can be measured. The successful application of this theory may lead to a considerable revision of our thoughts about holotypes. Even if a neotype has been selected and doesn't conform with the description of the population to which the lost holotype probably belonged, as might be shown by an examination of the work of a second revisor, it too may be fitted into a population. The names may then be correctly applied, and any nomenclatural adjustments may be made. This method would go a long way toward eliminating the need for complex rules of nomenclature and permit easy handling of these procedural matters by the systematist.

The phenogram procedure may be compared with the keying of a specimen for identification. The major difference is that all decisions are based on a study of the various natural populations, independent of any previous treatment by taxonomists. Here is an example of how I used this system to revise the genus *Oxacis*. There was no comprehensive monograph of the genus for any area, thus necessitating an examination of all of the literature, available types, and museum specimens, as well as all of the other normal procedures required of alpha taxonomic work. I then ignored the species-group names where type specimens were non-existent and the descriptions were so poor that the species couldn't be recognized. These names were listed, but no further consideration was given to them at that time. Next, I was concerned with two things: the species that were discovered by studying as many populations as possible, and the probable species known only from a few samples. As a speciationist, I was concerned with the variants and isolates. An interest in the classification of the entire family as well, required me to make use of this revision as a part of the classification of the higher groups. In other words, a genetic concept was formed also. This com-

pleted, it became necessary to assign holotypes to populations enabling the proper application of species-group names. In the case of species based on a knowledge of only one or a few population samples, the species were either referred to as typological species if a holotype were available, or if not, then these were described as unassigned populations (and remain unnamed). Once this was done there was no longer a need to refer to systematic work published prior to the date of my revision (Arnett, mss.) unless I desire to and have the opportunity to do so. I, however, may find it necessary at a later date to rearrange taxa using newly available data.

There is no need to "pass judgement on" previous work with the view of discarding the work of the taxonomist. The individual always makes the decision on what work is acceptable and what is rejected. The acceptance is indicated by the use of the work in question. The rejection is signified by the publication of a subsequent revision or monograph. The procedure described here for the treatment of all taxonomic literature enables the placing of all work but does not oblige the population systematist to do so. He is not required, when his primary concern is populations, to search out and insert every old "species" into his treatment of natural species. However, by using this system, he may, at any time, add old, overlooked, or subsequent species descriptions to the work. This is the system used by most field biologists, including those concerned with pest management; they do not delay their research waiting for the snail-paced taxonomist to untangle 200 years of archaic literature.

The following is a summary of the proposals made above. To follow these, I believe, will not only enable the modern population systematist to carry on his work without the long standing impediments of nomenclature but will speed up the process of alpha taxonomy for the systematist interested in faunistics.

1) Study populations of animals using every available technique to delimit the natural breeding populations. Do this first with the minimum use of previous literature. By doing so, one can form unprejudiced concepts of species. Many workers advocate starting without reference to literature, but few have actually done so. As far as possible the populations should be analyzed and compared species by species throughout the genus and from genus to genus throughout the family.
2) By means of the phenogram method, or similar procedure, describe the species of a genus using as the basis for the description an analysis of the characters and their variation as found in the populations studied. The isolates, if any, should be carefully and fully described in terms inclusive enough so that they can be recognized when additional specimens need to be identified. Scatter diagrams, comparative tables, and refined statistical treatment of the data should be used wherever there are available data.

3) If there is a comprehensive work available then the results of 1) and 2) can be collated with such works. For example, the exhaustive monograph of the Onychophora by Bouvier (1905-1907) makes all reference to earlier literature unnecessary. No doubt a thorough restudy of all previous work would reveal nomenclatural errors in Bouvier's work, but what possible useful purpose would be served? If such a work is not available then step 4) must be followed.
4) The use of copying machines makes the World's literature readily available to any worker. To prepare a catalog and to determine type localities is time consuming, but eventually necessary. The assigning of available names to the material at hand should now be so simple as to be almost routine. Holotype specimens that are readily available can be placed in the proper variational spectrum of the species by following the procedure discussed previously. As emphasized before, obscure descriptions, unrecognizable species and unavailable holotypes need not be considered further at this time.
5) Some groups have been particularly overworked by taxonomists or, even worse, by incompetent amateurs. In exceptional cases, the majority of the available names in a group for major areas have been validated by such workers, and many of the holotypes destroyed through lack of proper care or by accident. After a reasonable attempt is made to place the names involved, they should receive little further consideration, thus saving vast amounts of time and money. This will not be difficult to do except for the systematist who persists in following the outmoded taxonomy of pre-Darwinian days. Those who follow the recommendations of 1) will find this the easiest step in these procedures. As long as it is kept in mind that the proposed system is an open ended one and any of these difficult names can be placed at any time if new data become available, then the chance of evoking anarchy in our science by such a procedure is non-existent.

Currently, it seems, the twentieth century systematist is still chained to a nineteenth century methodology which does not fit the new concepts of species. Great strides have been made to develop a suitable methodology, e.g., biometry, refined collecting methods, field experimentation, and laboratory study of living material. A better system for filtering and treating current and past literature is badly needed. The "new systematics" has gotten old and is increasingly haunted by its stilted ancestor—nomenclature.

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2.0035 **The type locality and the study of natural populations.** Abstract.— The use of topotypic material and the study of the holotype population provides an objective means of relating the name of an organism to the living insect, leaving the study of the polymorphism of contemporary populations unhampered by nomenclatural legalities.— **Ross H. Arnett, Jr.,** *Department of Entomology, Purdue University, Lafayette, Indiana 47907.*

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